REMARKS

The Examiner is thanked for the due consideration given the application.

The specification has been amended to clarify equations pertaining to ε(critical), as is evidenced by Non-Patent Document 7: *Journal of Crystal Growth,* Vol. 27, pp. 118 to 125, 1974, which has been incorporated by reference in the specification.

Claims 9-28 are pending in the application. Claims 9 and 14 have been amended to clarify equations 2 and 4. Claims 25-28 are newly presented. Support for new claims 25 and 27 can be found in the specification in paragraph 0029. Support for new claims 26 and 28 can be found in the specification in paragraph 0037.

No new matter is believed to be added to the application by this amendment.

Rejection Under 35 USC §112, Second Paragraph

Claims 9 and 14 have been rejected under 35 USC §112, second paragraph, as being indefinite.

The Official Action asserts that the average strain equation in claim 9 is indefinite because the equation does not calculate the average strain in all the layers.

$$\varepsilon\ (\text{average}) = \frac{\sum_{i=1}^{n} (\varepsilon i \times di)}{d} \qquad d = \sum_{i=1}^{n} di$$

However, the average strain is clearly defined as a numerator of a summation under i of strain multiplied by thickness of the laminated layer, over a denominator of a summation under i of thickness of the laminated layer, indicating an average value.

Also, even if one assumes that there is any deviation from the conventional concept of average, the equation shows a clear relationship where the applicant is entitled to be his or her own lexicographer. See, e.g., *In re Paulsen*, 30 F.3d 1475, 1480, 31 USPQ2d 1671, 1674 (Fed. Cir. 1994).

That is, although d values can be found in both the numerator and the denominator of the equation, a strain value that is mathematically clear is being set forth.

Claim 9 (and also claim 14, which also sets forth the equation at issue) is thus clear, definite and has full antecedent basis.

This rejection is believed to be overcome, and withdrawal thereof is respectfully requested.

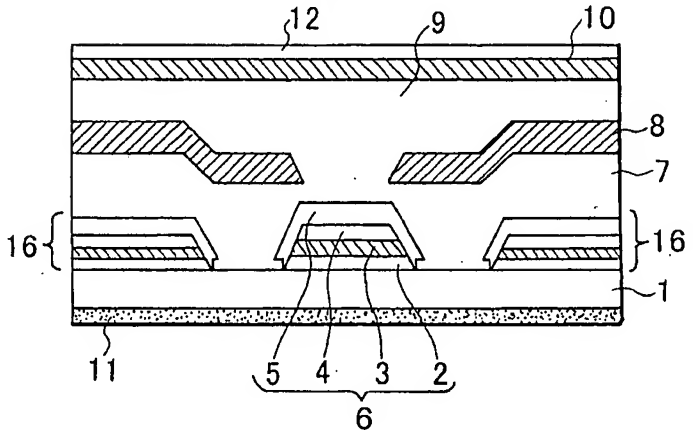
Rejection Under 35 USC §103(a)

Claims 9-24 have been rejected under 35 USC §103(a) as being unpatentable over SAKATA (U.S. Patent 5,847,415) in view of NAKA et al. (U.S. Patent 4,701,927), G.P. AGRAWAL (*Semiconductor Lasers Past, Present, and Future*, American Institute of Physics, 1995) and S.L. CHUANG (*Physics of Optoelectronic Devices*, New

York, John Wiley & Sons, 1995). This rejection is respectfully traversed.

The present invention pertains to a laser having a double hetero mesa-stripe positioned to optimize compressive strain that is illustrated, by way of example, in Figure 1 of the application, which is reproduced below.

FIG. 1



The mesa stripe 6 includes a quantum well 3 sandwiched by optical confinement layers 2 and 4, and a cap layer 5 is over the structure. The mesa stripe 6 is surrounded on both sides by blocking layers 7 and 8. The p-type cladding layer 9 is not blocked by the blocking layers above the mesa structure. See new claims 19-24.

However, Figure 1 shows the post-growth status covering the current layer and the cladding layer, and it therefore appears that the p-type blocking layer and the p-type cladding layer as being integrally formed, which is inconsistent with the

function of the current blocking layer as shown in the manufacturing process in Figure 2 of the application. In the present invention, the current path is formed on the active-layer mesa.

The laser geometry of the present invention permits the utilization of the average and critical compressive parameters set forth in equations 1 and 2:

[Equation 1]

$$\varepsilon\ (\text{average}) = \frac{\sum_{i=1}^{n} (\varepsilon i \times di)}{d} \qquad d = \sum_{i=1}^{n} di$$

[Equation 2]

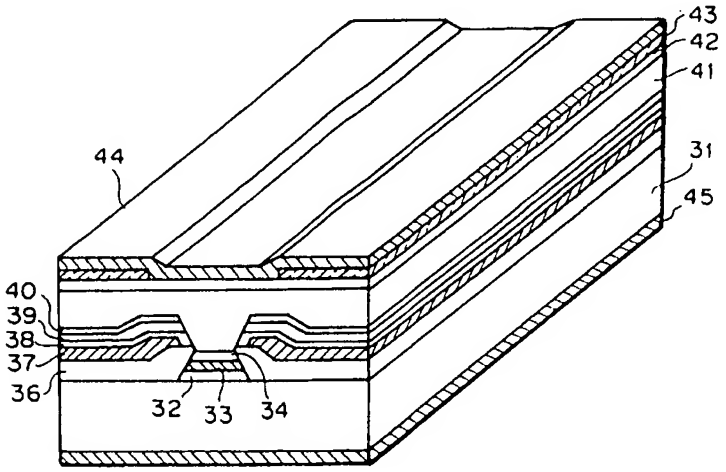
$$\varepsilon(\text{critical}) = \frac{b}{4\pi d(\text{critical})} \cdot \frac{1\text{-}p\,(\cos\alpha)\hat{}2)}{(1+p)\cos\lambda} \cdot \{\ln(\frac{d(\text{critical})}{b}) + 1\}$$

The optimal and novel strain relationship is set forth in independent claims 9 and 14, which are important component of the present invention and state: "an average strain amount ε1(average) of the double hetero mesa-stripe is a compression strain (ε1(critical) ≥ ε1(average) > 0, and

an average strain amount ε2(average) of the recombined layer is a tensile strain (-ε2(critical) ≤ ε2(average) < 0) not more than a critical strain amount ε2(critical) or zero strain (ε2(average) = 0)."

SAKATA pertains to multi-quantum-well buried heterostructure laser diodes. The Official Action refers to Figure 4 of SAKATA, which is reproduced below.

FIG. 4



SAKATA fails to disclose or suggest if the average strain amount relates to the compression strain or the tensile strain the double hetero mesa-stripe and the recombined layer, respectively.

However, the Official Action asserts that equation 1 would be inherent in SAKATA.

However, there has been no showing of how the mathematical relationships of equation 1 would be inherent in SAKATA. Even if inherency could be shown, this would be no bar to patentability because SAKATA fails to recognize the importance of these mathematical relationships.

Accidental results not intended and not appreciated do not constitute anticipation. *Eibel Processing Co. v. Minnesota and Ontario Paper Co.*, 261 US 45 (1923); *Mycogen Plant Science, Inc. v. Monsanto Co.*, 243 F.3d 1316, 1336, 5 USPQ2d 1030, 1053 (2001). The Federal Circuit stated in *In re Robertson*, that "to establish inherency, extrinsic evidence must make clear that the missing descriptive matter was necessarily present in the thing described in the reference, and would be so recognized by persons with ordinary skill. Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a set of circumstances is not sufficient." *In re Robertson*, 169 F.3d 743, 745, 49 USPQ2d 1949 (Fed. Cir. 1999). Further, it has been held that the mere fact that a certain thing may result from a given set of circumstances is not sufficient, and occasional results are not inherent. *MEHL/Biophile International v. Milgraum*, 192 F.3d 1362, 1365, 52 USPQ2d 1303 (Fed. Cir. 1999).

The Official Action acknowledges that SAKATA fails to disclose a cap layer, average strain amount of double hetero mesa stripe is a compression strain and an average strain amount of the recombination layer is a tensile strain. The Official Action refers to Figure 1 of NAKA et al., reproduced below, for these teachings.

FIG. 1 (PRIOR ART)

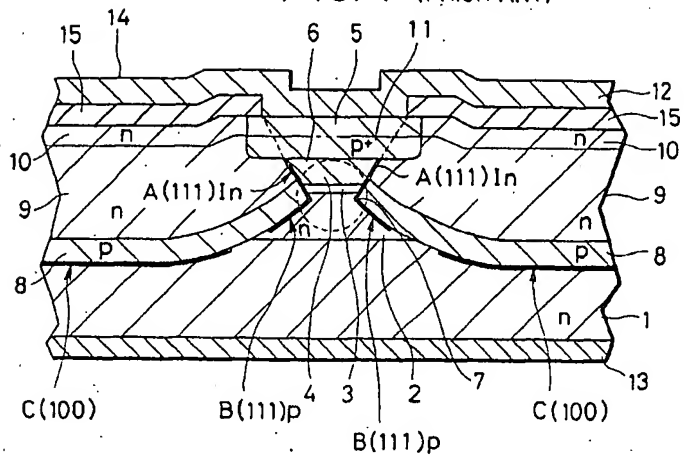


Figure 1 of NAKA et al. shows a cap layer 5. However, it is respectfully noted that the present invention does not set forth a cap layer until dependent claim 19.

NAKA et al. fail to disclose that the average strain amount of double hetero mesa stripe is a compression strain and an average strain amount of the recombination layer is a tensile strain.

The Official Action refers to S.L. CHANG for teachings pertaining to a compressively strained quantum well structure achieving a lower threshold current density and favors TE polarization, while tensile strained active layers favor TM polarization. However, these teachings of S.L. CHANG fail to address the deficiencies of SAKATA, G.P. AGRAWAL and NAKA et al. discussed above.

One of ordinary skill and creativity would thus fail to produce a claimed embodiment of the present invention from a

knowledge of SAKATA, G.P. AGRAWAL, NAKA et al. and S.L. CHANG, and a *prima facie* case of unpatentability has thus not been made.

Further, the present invention shows unexpected results that would rebut any unpatentability that could be alleged. The unexpected results of the present invention are typified by Figures 3 and 4 of the application, which are reproduced below.

FIG.3

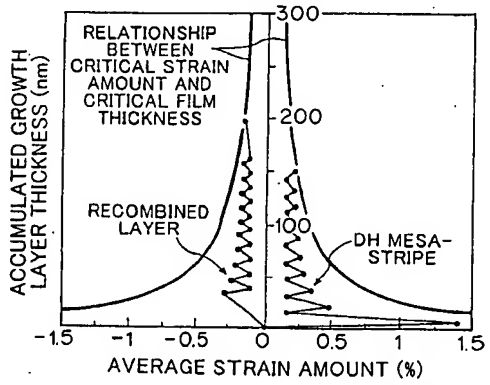
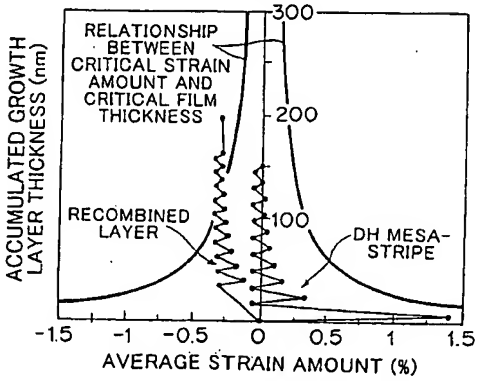


FIG.4

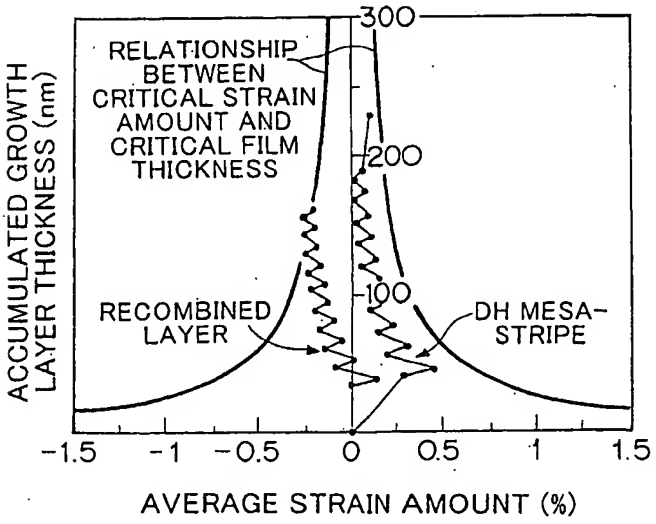


Figures 3 and 4 are calculation results of relationships between average strain amounts of strained growth layers and growth layer thicknesses with respect to the DH mesa-stripe 6 and the recombination layer 16. Points indicated by

black solid circles denote average strain amounts (%) and total thickness (nm) of grown layer after the semiconductor layers are sequentially grown, and show results of growth from a first layer of strained growth layers to a final strained growth layer. In Figures 3 and 4, an average strain amount ε1 (average) of the DH mesa-stripe 6 is shifted to a compression-strain side within a critical strain amount ε1 (critical) to reduce a tensile strain amount ε2 (average) of the recombination layer 16 on the broad portion and to suppress lattice relaxation. See claims 25 and 27.

Figure 6, reproduced below, is a calculation result showing a relationship between an average strain amount of a strained growth layer and a growth layer thickness with respect to a DH mesa-stripe and a recombination layer of a broad portion in an embodiment of the present invention.

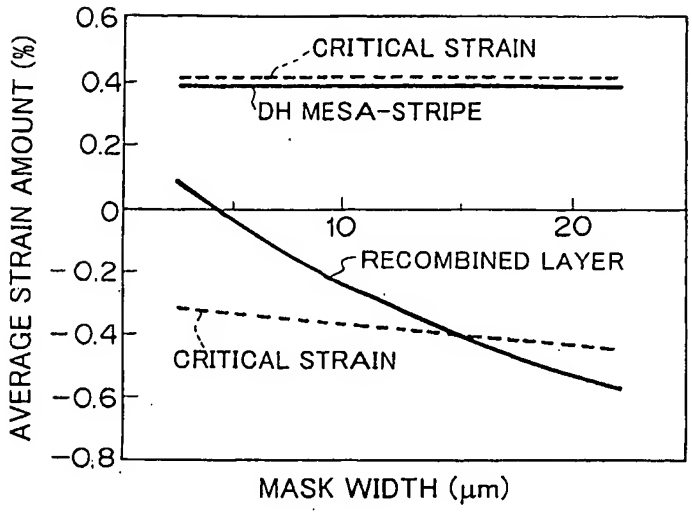
FIG.6



As shown in Figure 6, the average strain amount ε1(average) of the DH mesa-stripe and the average strain amount ε2(average) of the recombination layer 16 shift to the compression-strain side by the compressive strain given to the optical confinement in comparison with the structure shown in FIG. 4. As a result, it is understood that both the average strain amounts are the critical strain amount or less. See claims 26 and 28.

Additional results are shown in Figure 7, which is reproduced below.

FIG.7



As shown in Figure 7, as the mask width increases, the average strain amount of the recombination layer shifts to a tensile-strain side. As a result, when the mask widths exceed 15 μm, the average strain amount of the recombination layer exceeds the critical strain amount, lattice relaxation may occur. Therefore, the mask width of a dielectric material used in selective growth is desirably larger than 0 and equal to or smaller than 15 μm. See claim 18.

As a result, the present invention displays unexpected results that fully rebut any unpatentability that could be alleged.

This rejection is believed to be overcome, and withdrawal thereof is respectfully requested.

Statement of Substance of Interview

The Examiner is thanked for graciously conducting a personal interview with the applicant's representative on December 24, 2008. During the interview the patentability of the present invention over the applied art references was discussed, as well as the definiteness of the claims. At the end of the interview the Examiner prepared an interview summary. The interview summary has been reviewed, and it appears to accurately reflect the substance of the interview.

Conclusion

The Examiner is thanked for considering the Information Disclosure Statement filed May 26, 2006 and for making an initialed PTO-1449 Form of record in the application.

Prior art of record but not utilized is believed to be non-pertinent to the instant claims.

The rejections are believed to have been overcome, obviated or rendered moot and that no issues remain. The Examiner is accordingly respectfully requested to place the application in condition for allowance and to issue a Notice of Allowability.

The Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 25-0120 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17.

Respectfully submitted,

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